MR No. L4L26

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WARTIME REPORT

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CHARTS SHOWING STABILITY AND CONTROL CHARACTERISTICS OF AIRPLANES IN FLIGHT

By Stability and Control Section
of Flight Research Division

Langley Memorial Aeronautical Laboratory
Langley Field, Va.

NACA

WASHINGTON

MR No. L4L26

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Army Air Forces, Air Technical Service Command

and the

Bureau of Aeronautics, Navy Department

CHARTS SHOWING STABILITY AND CONTROL CHARACTERISTICS OF AIRPLANES IN FLIGHT

By Stability and Control Section
of Flight Research Division

INTRODUCTION

During October 1944, the National Advisory Committee conducted a series of conferences with the Army, Navy, and representatives of the aircraft industry for the purpose of discussing the flight-test procedures used in measuring the stability and control characteristics of airplanes. The conferences were initiated by the Army Air Forces, Air Technical Service Command, to acquaint the flight organizations of the industry with the flight test methods employed by the NACA and to standardize the techniques insofar as possible as they are employed by the various manufacturers and agencies engaged in determining the flying qualities of airplanes.

To facilitate the discussion during the conferences a series of charts was presented which portrayed typical good and undesirable airplane characteristics as determined in flight. The discussion centered around the characteristics portrayed and their relation to the Army Air Forces specifications for the stability and control of airplanes (reference 1). In general the following points were covered in connection with each chart:

(a) The purpose of the test

(b) The flight technique used

(c) Items recorded

(d) Evaluation and interpretation of data obtained

There were many requests from the conferees for copies of the charts presented for their further study and for reference with their notes taken during the discussion. Accordingly, the charts have been reproduced and are presented herein.

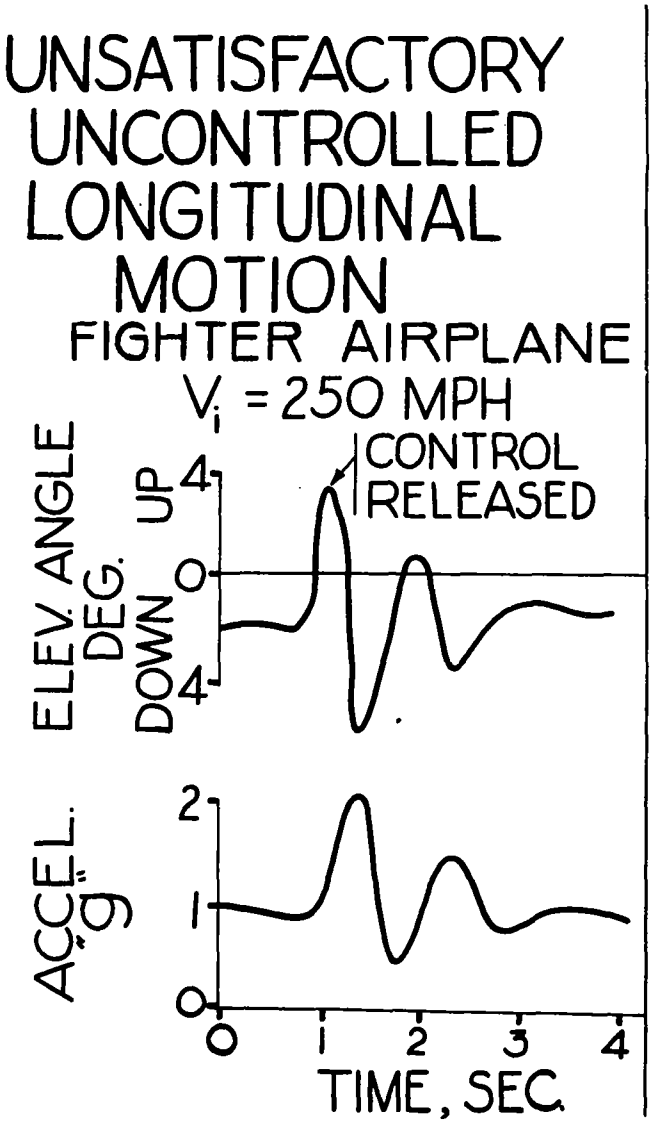
During the discussion there were many additional explanatory figures drawn on the blackboard so that the more formal charts do not give a complete picture of the material presented and discussed.

The conferences were held at both the Langley and Ames Laboratories of the NACA and a separate series of charts was presented by each group. Because of the similarity of the charts, however, only the charts presented at the Langley conference are given herein.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., December 26, 1944.

REFERENCE

1. Anon.: Stability and Control Requirements for Airplanes. AAF Specification No. C-1815, Aug. 31, 1943.



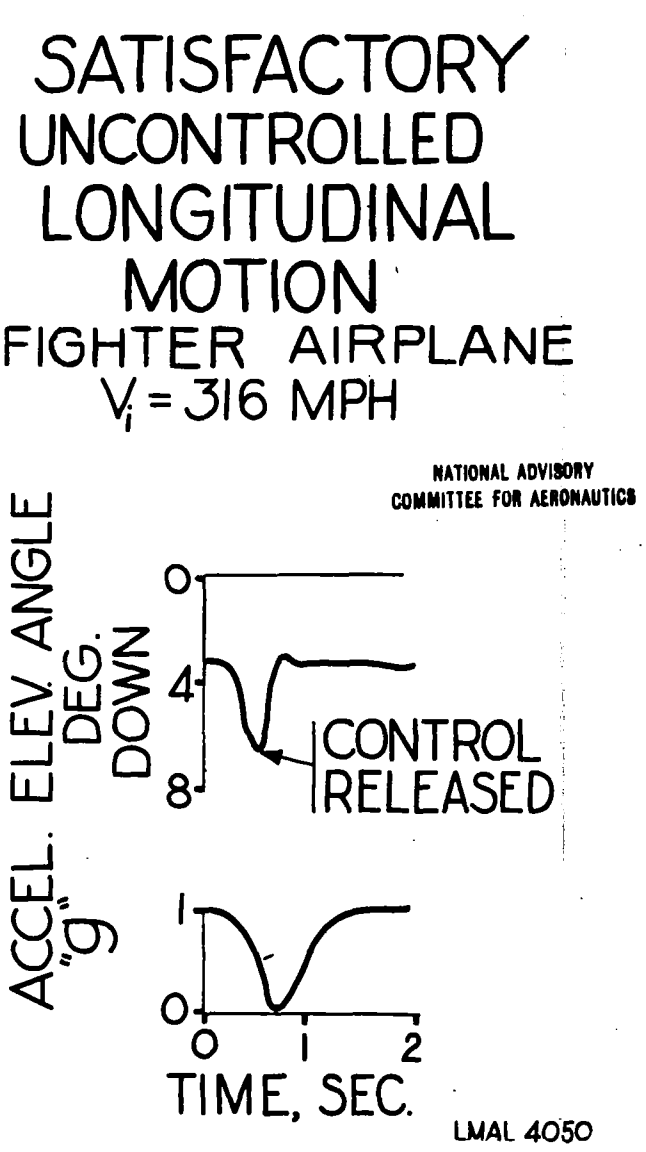


Figure 1.

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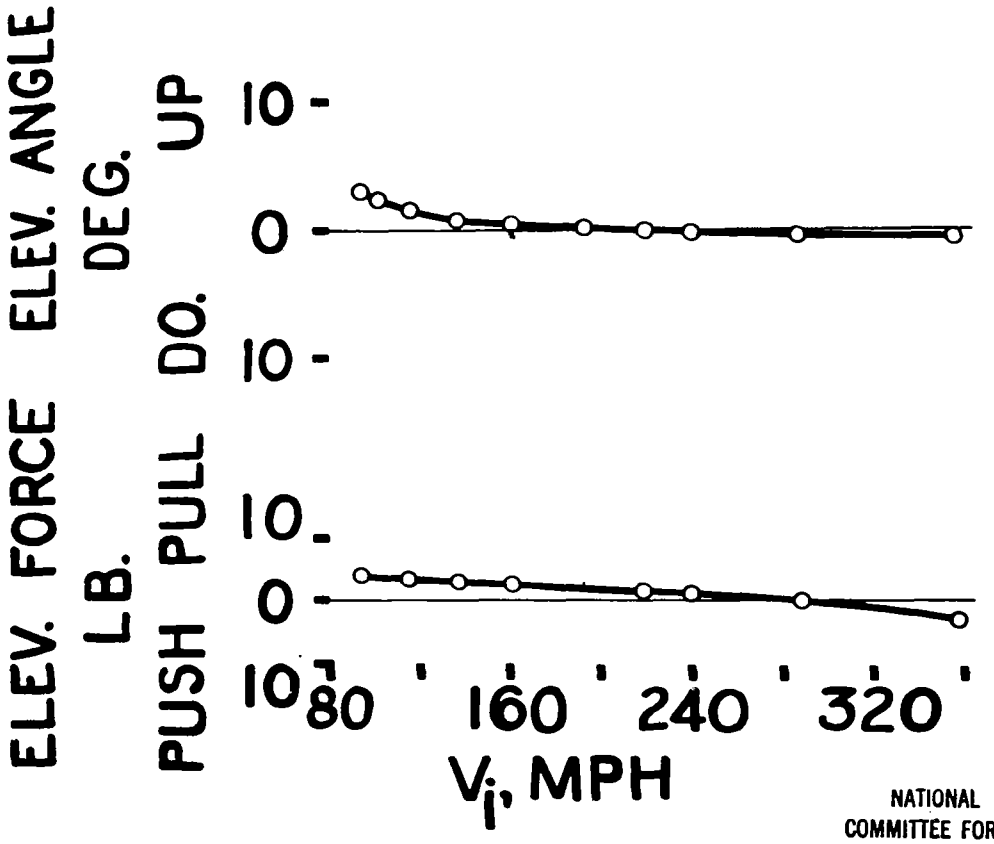
SATISFACTORY STICK FIXED AND STICK FREE STATIC LONGITUDINAL STABILITY

FIGHTER AIRPLANE
CLIMBING CONDITION



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LMAL 4055

Figure 2.

UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

FIGHTER AIRPLANE

GLIDING CONDITION

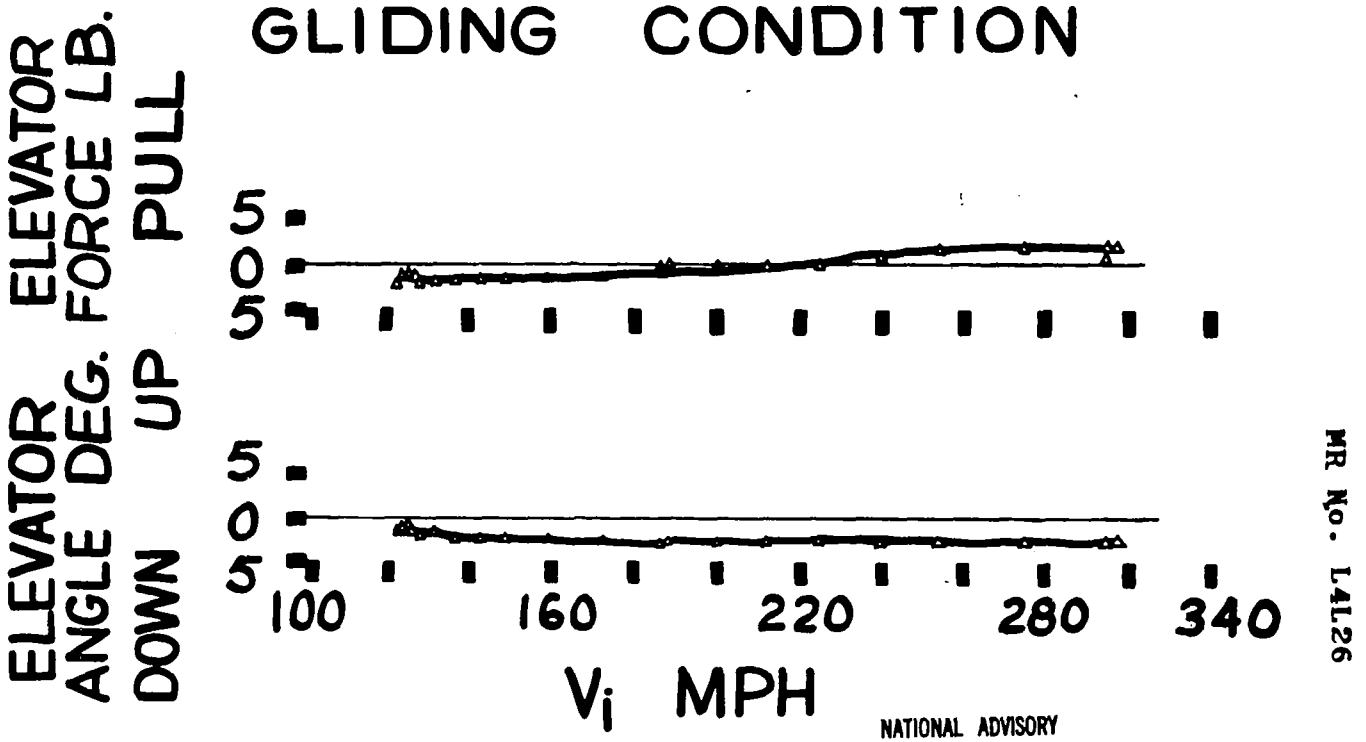

Figure 3.

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LMAL 4051

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UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

FIGHTER AIRPLANE
CLIMBING CONDITION
RATED POWER, CLEAN

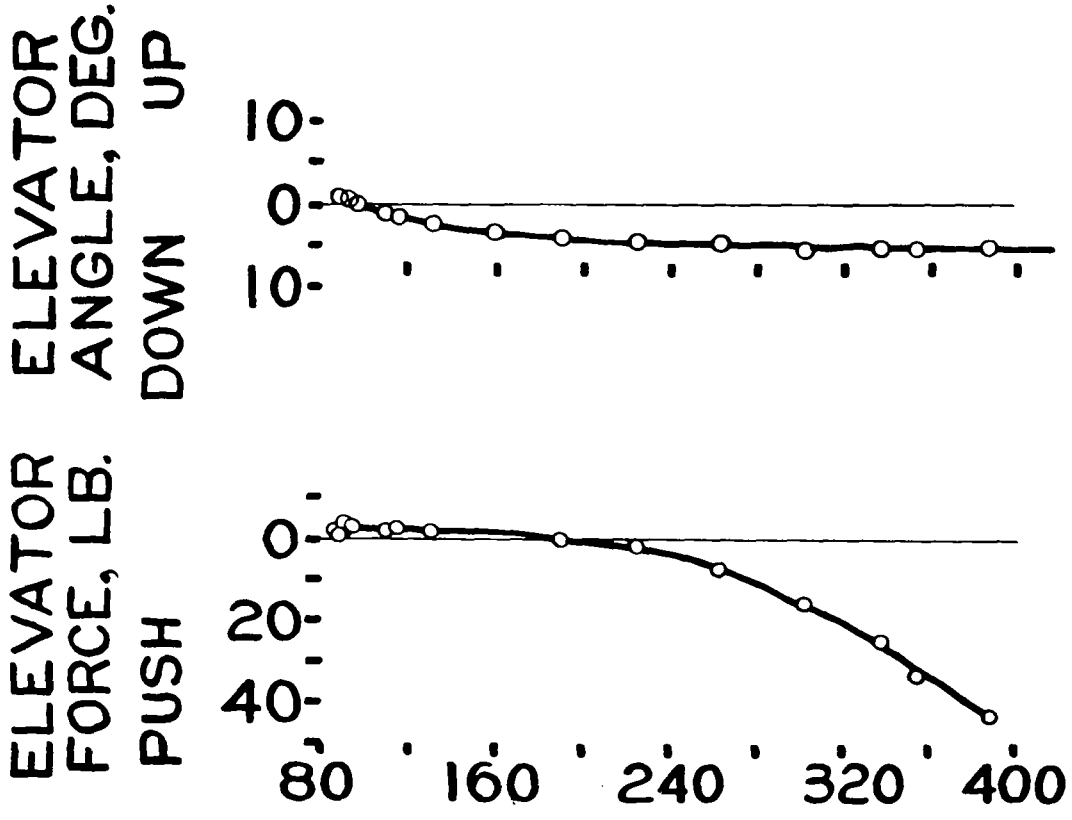

Figure 4. NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS LMAL 4052

UNSATISFACTORY STICK FREE LONGITUDINAL STABILITY

FIGHTER AIRPLANE

CLEAN CONDITION, POWER ON

C.G. POSITION IN % M.A.C.

○ 22.85%

□ 27.3%

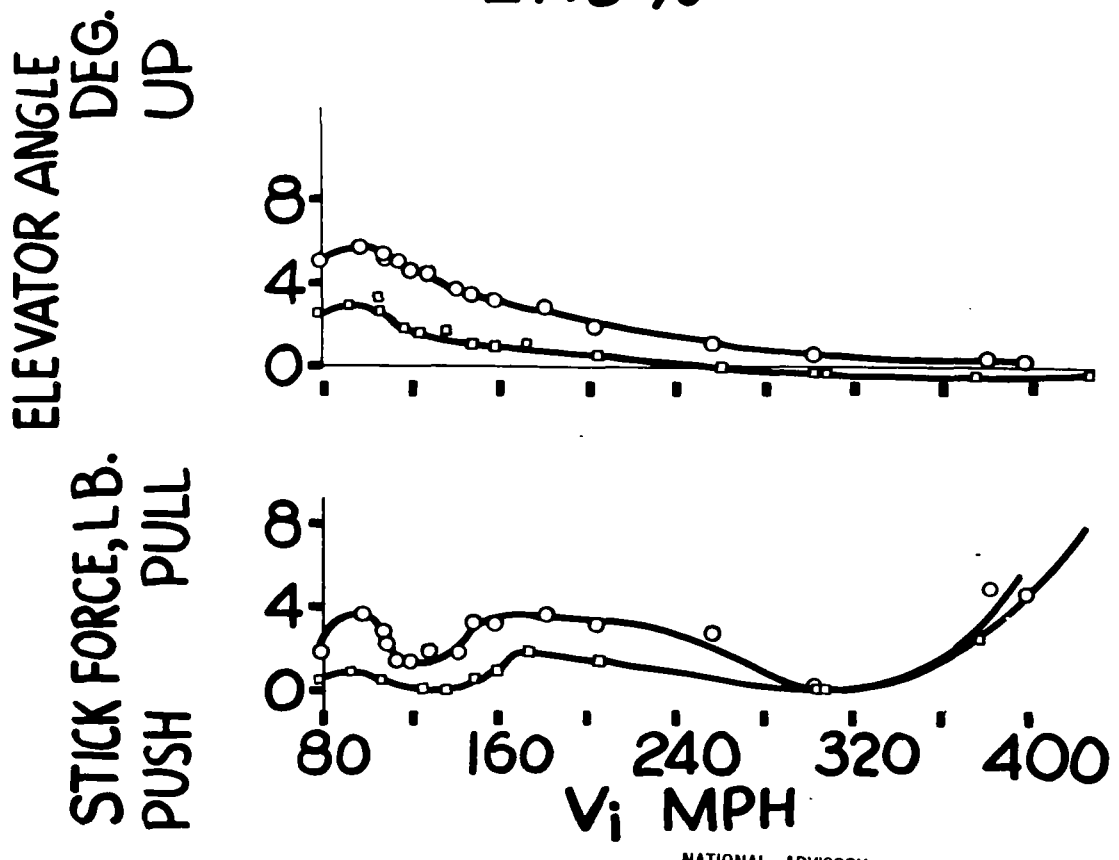

Figure 5.

UNSATISFACTORY STICK-FIXED LONGITUDINAL STABILITY

NAVY SCOUT BOMBER
CLIMBING CONDITION

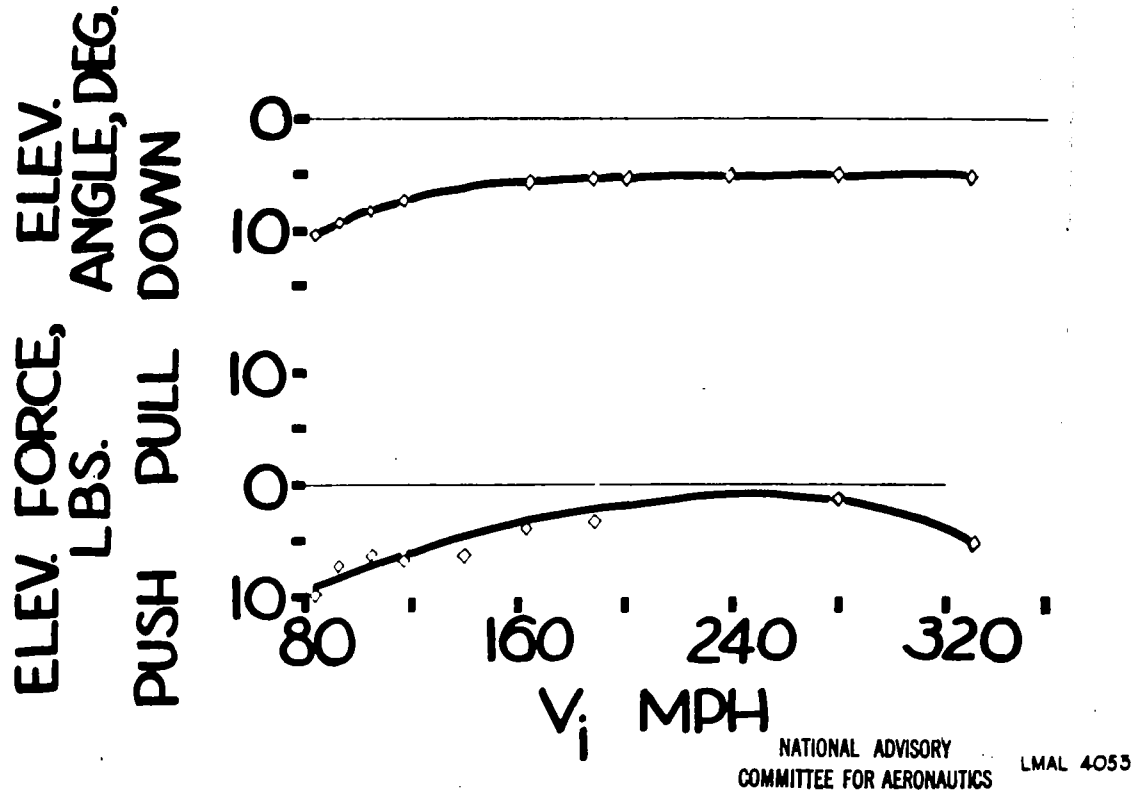

Figure 6.

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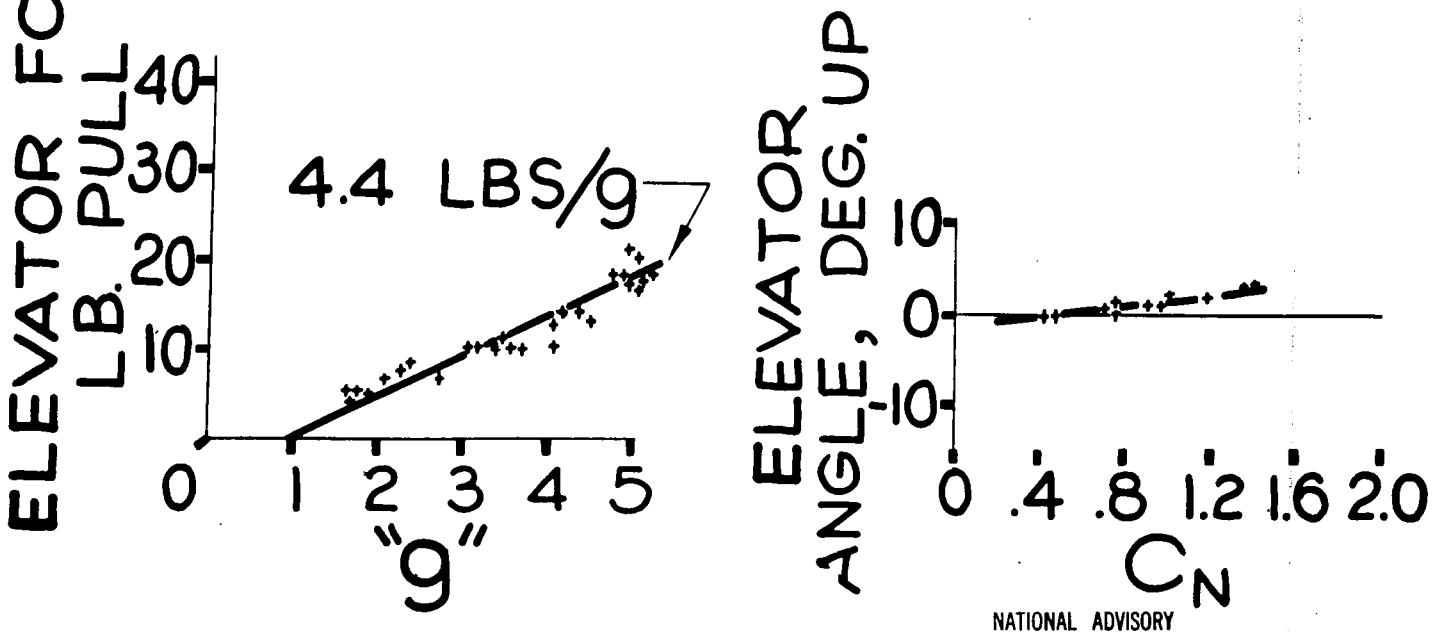
SATISFACTORY ELEVATOR FORCE CHARACTERISTICS IN ACCELERATED FLIGHT

FIGHTER AIRPLANE
CRUISING CONDITION



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LMAL4043

Figure 7.

UNSATISFACTORY STICK FORCE CHARACTERISTICS IN ACCELERATED FLIGHT

NAVY SCOUT BOMBER WITH EXP. BALANCE TAB

V_i = 170 MPH

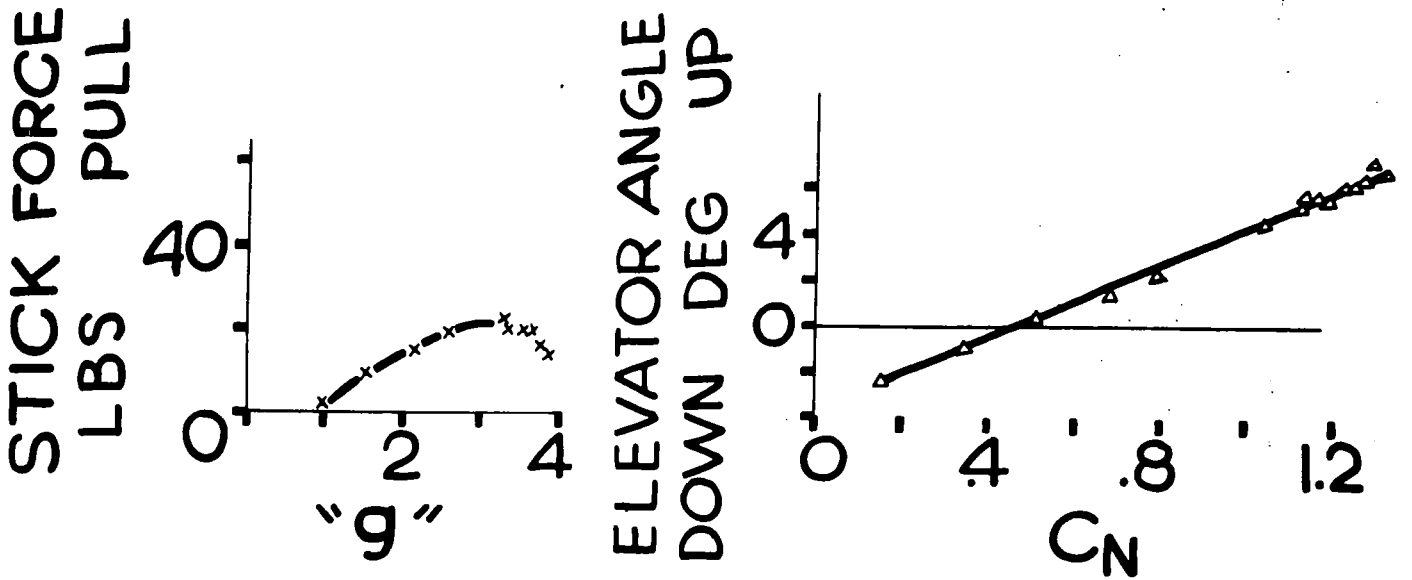

Figure 8.

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS LMAL 4054

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SATISFACTORY ELEVATOR CONTROL IN ABRUPT PULL-UPS - FIGHTER AIRPLANE

V_i = 188 MPH

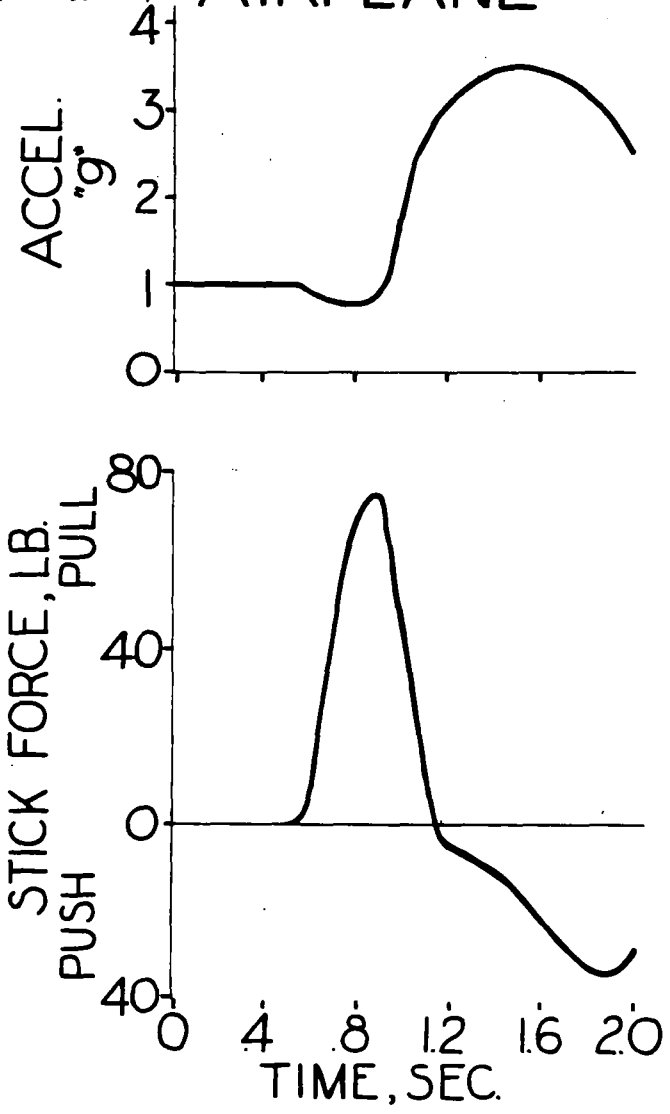

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Figure 9.

UNSATISFACTORY ELEVATOR CONTROL IN ABRUPT PULL-UPS - FIGHTER AIRPLANE V_i = 205 MPH

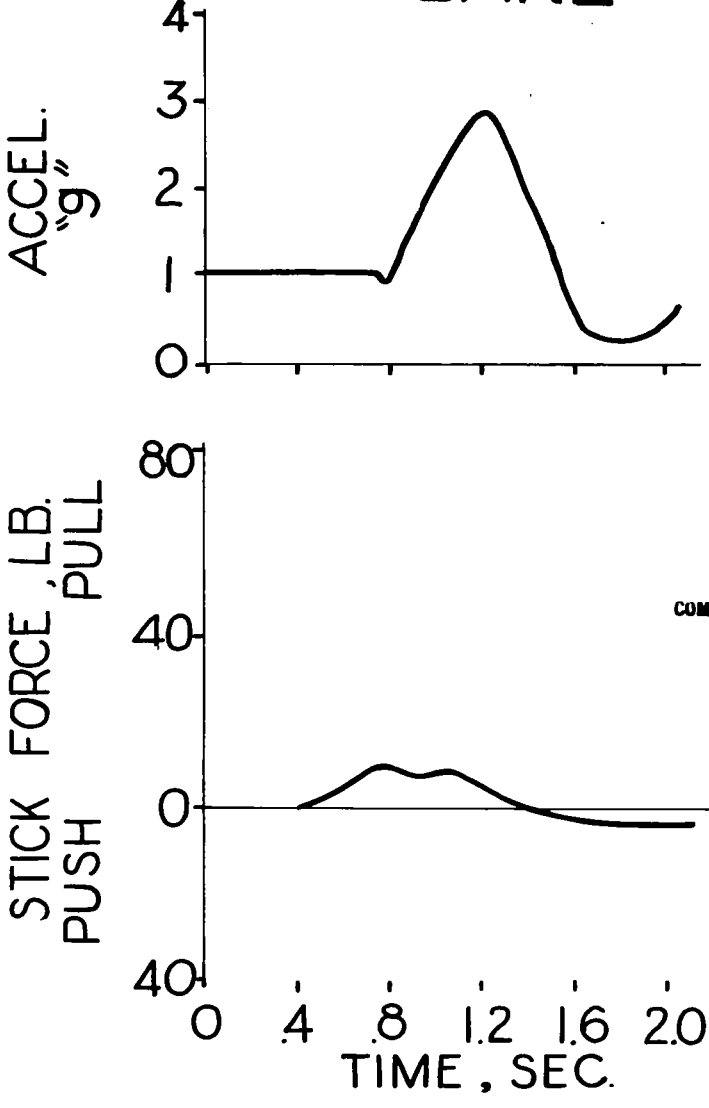

Figure 10.

LMAL 4045

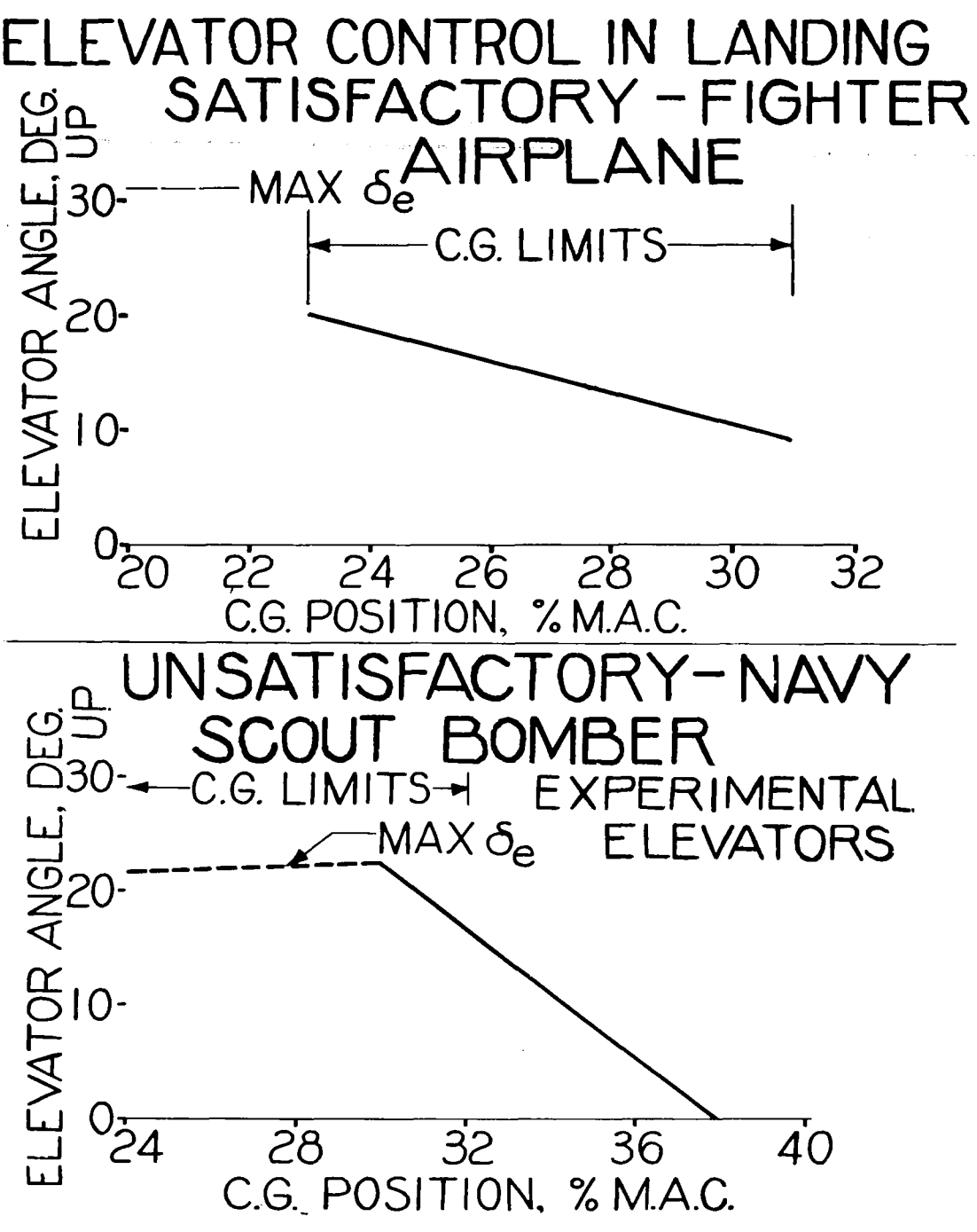

Figure 11.

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LMAL 4046

CHANGE IN ELEVATOR FORCE FROM CLIMBING CONDITION AT V_i = 120 MPH

CONDITION	FIGHTER AIRPLANE	NAVY SCOUT BOMBER
CLIMBING	0	0
GLIDING	.4 PULL	14 PULL
LANDING	5.1 "	14 "
WAVE-OFF	2.9 "	3.5 "
APPROACH	5.4 "	10.7 "

Figure 12.

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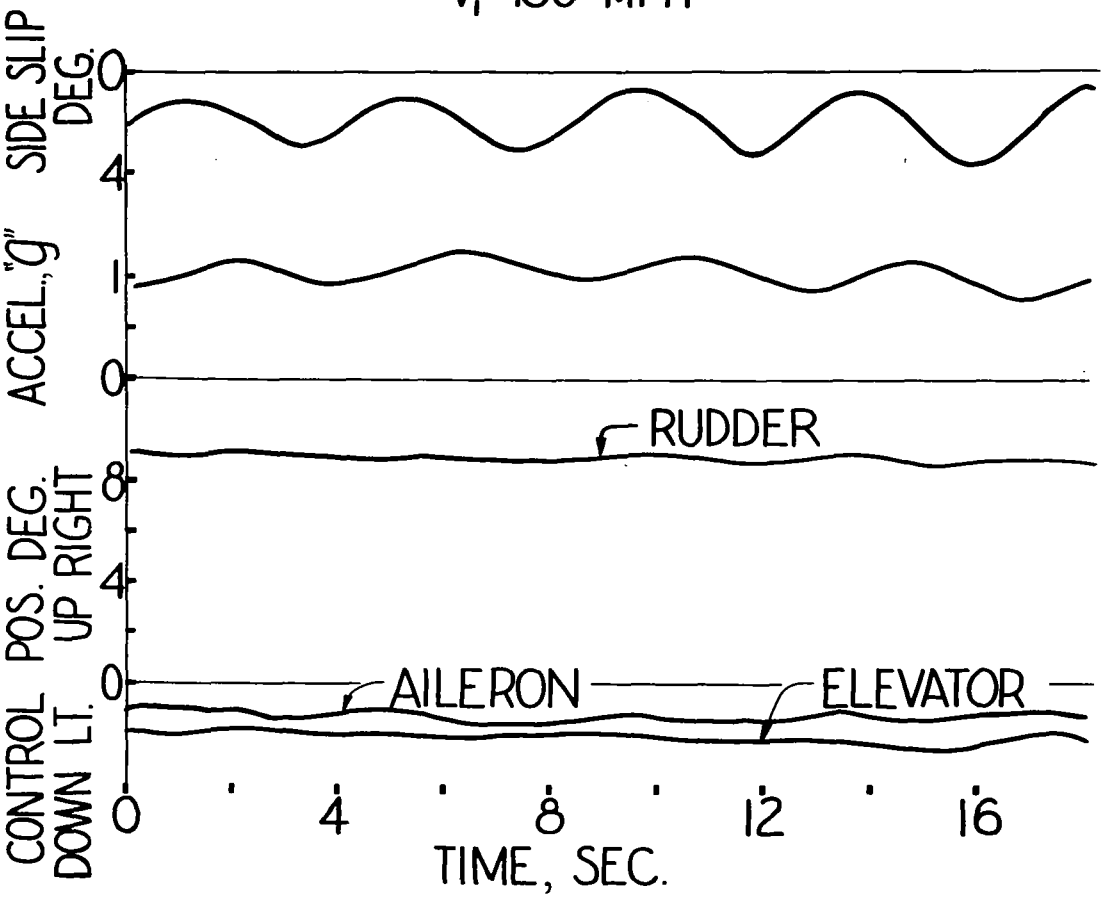
LMAL 4041

UNSATISFACTORY CONTROL FIXED OSCILLATION

FIGHTER AIRPLANE
V_i = 150 MPH



LMAL 4047

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Figure 13.

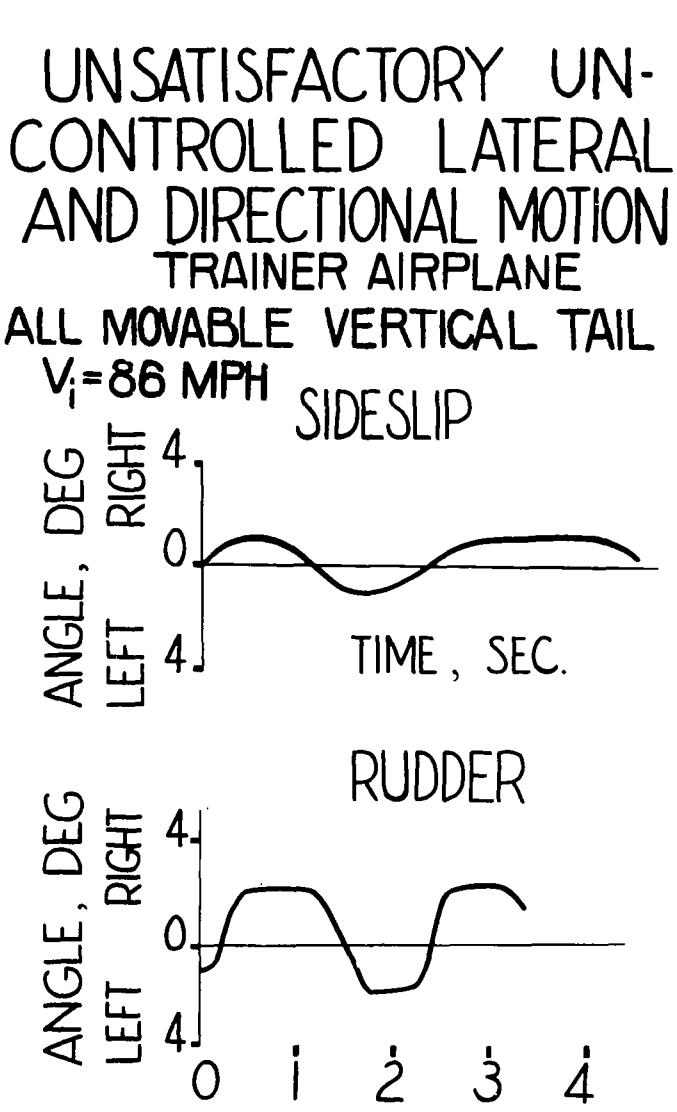

Figure 14.

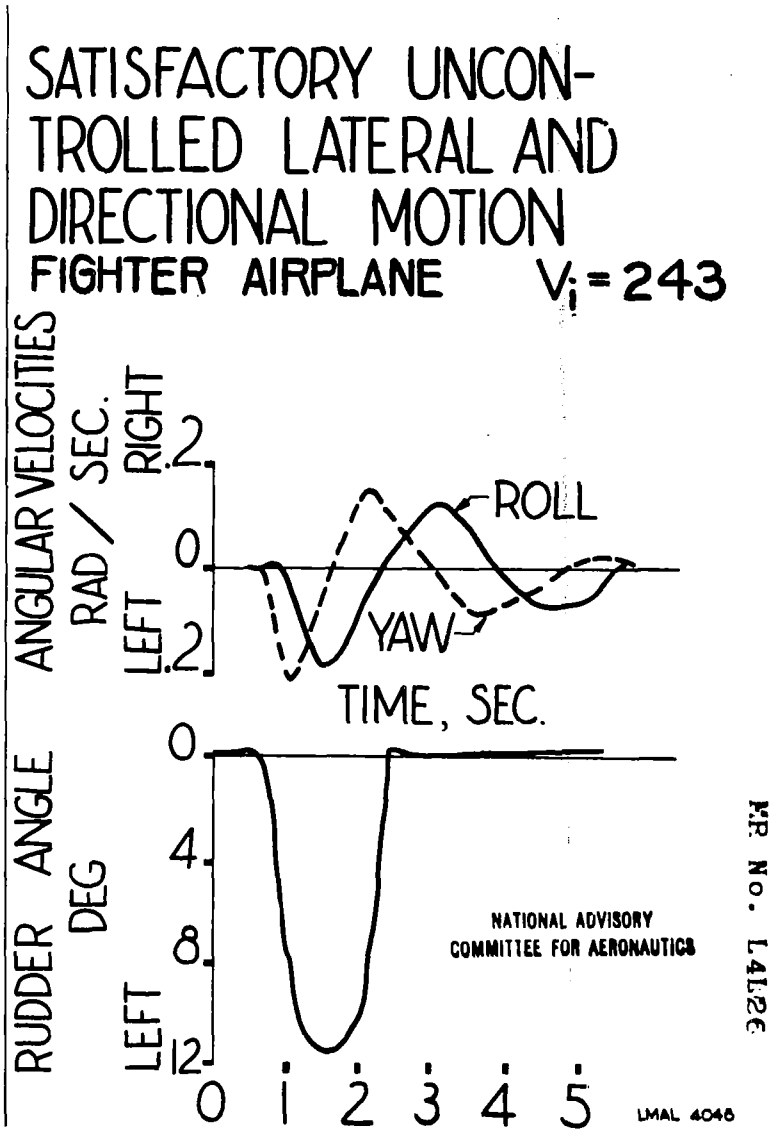

Figure 15.

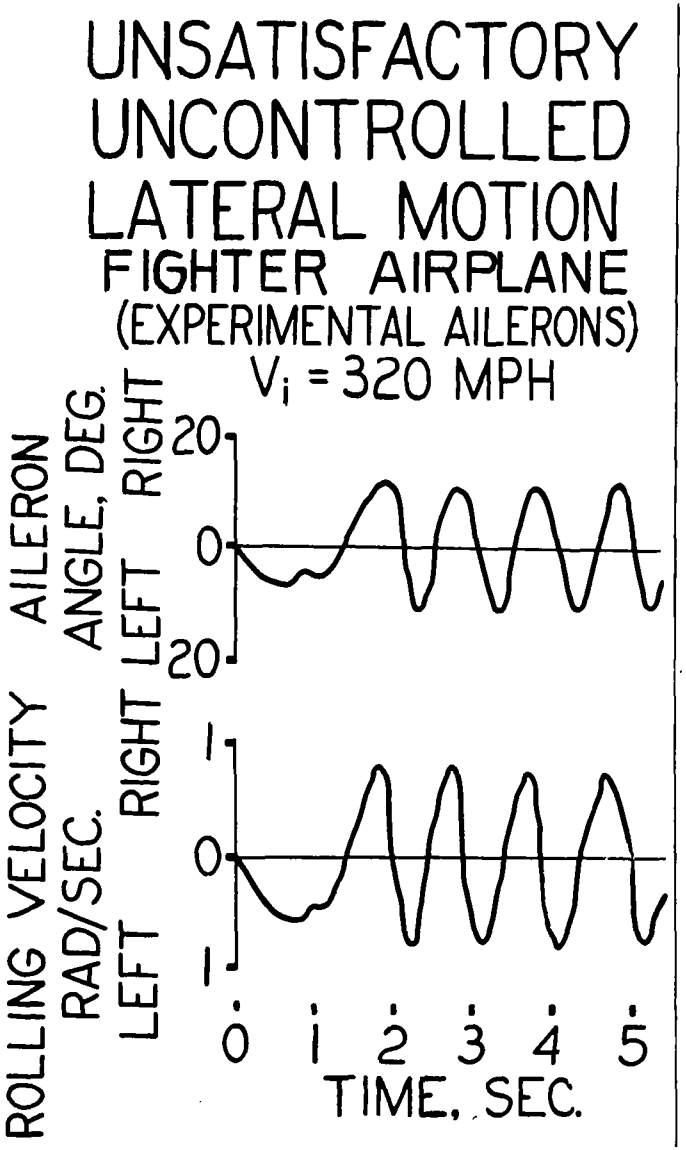

Figure 16.

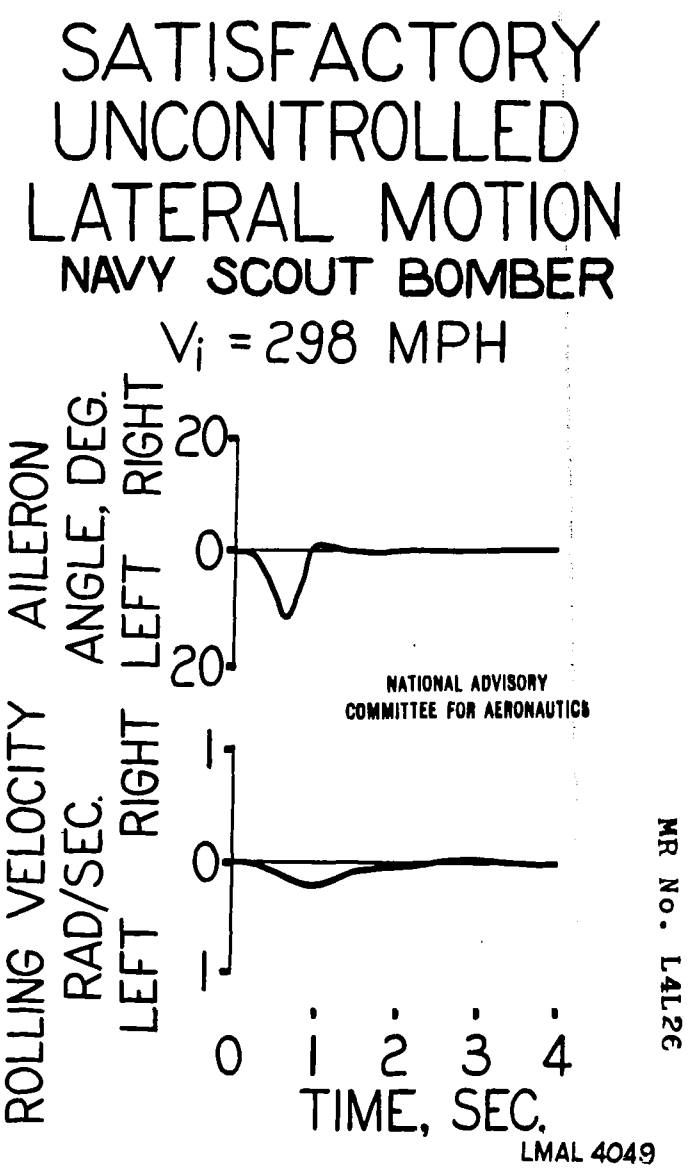

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Figure 17.

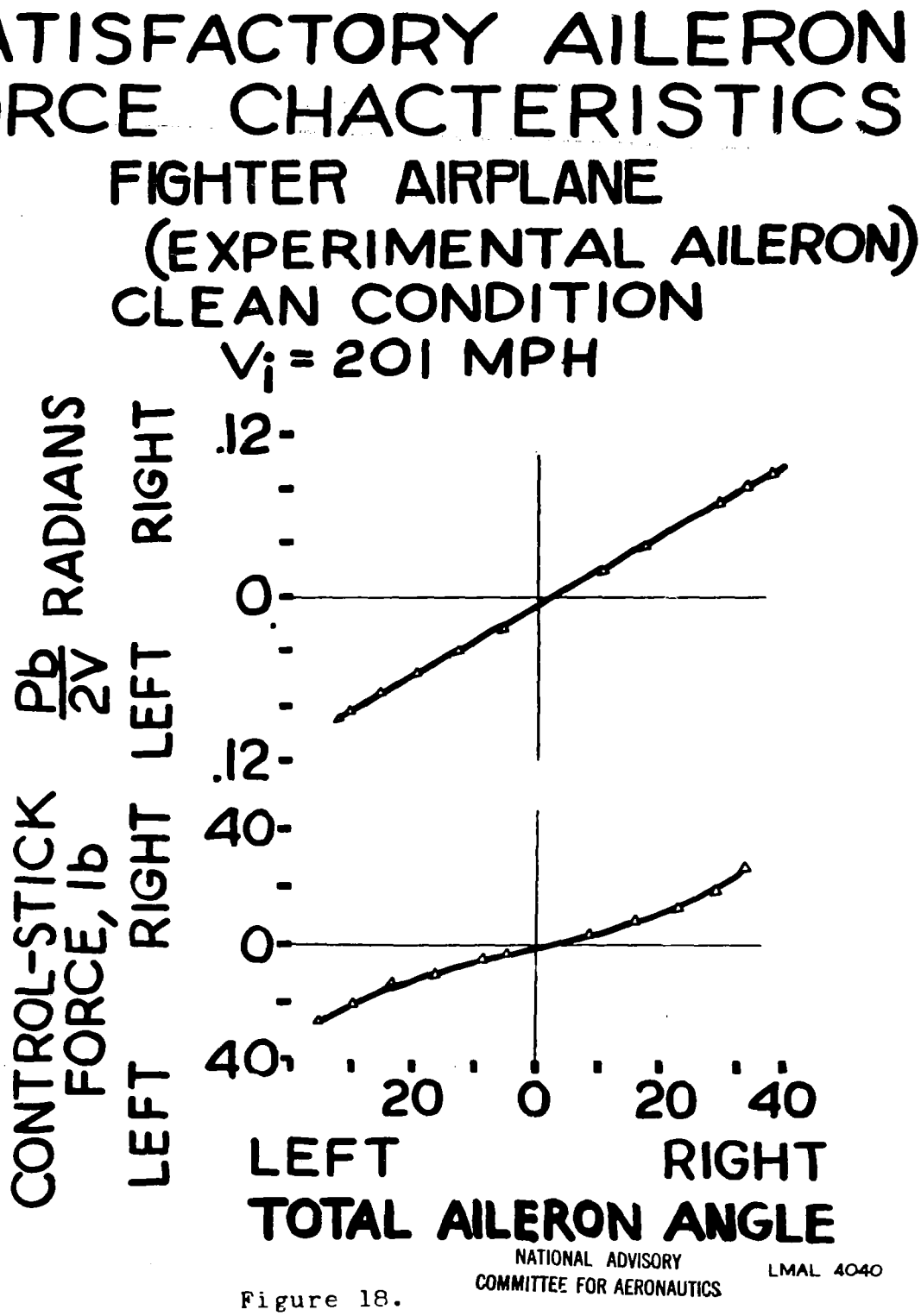
SATISFACTORY AILERON FORCE CHACTERISTICS
FIGHTER AIRPLANE
(EXPERIMENTAL AILERON)
CLEAN CONDITION
V_i = 201 MPH
$\frac{Pb}{2V}$ RADIANS
RIGHT
LEFT
.12
0
.12
CONTROL-STICK FORCE, lb
RIGHT
LEFT
40
0
40
20
0
20
40
LEFT
RIGHT
TOTAL AILERON ANGLE
NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS
LMAL 4040

Figure 18.

UNSATISFACTORY AILERON FORCE CHARACTERISTICS

FIGHTER AIRPLANE (CLEAN CONDITION) V_i = 210 MPH

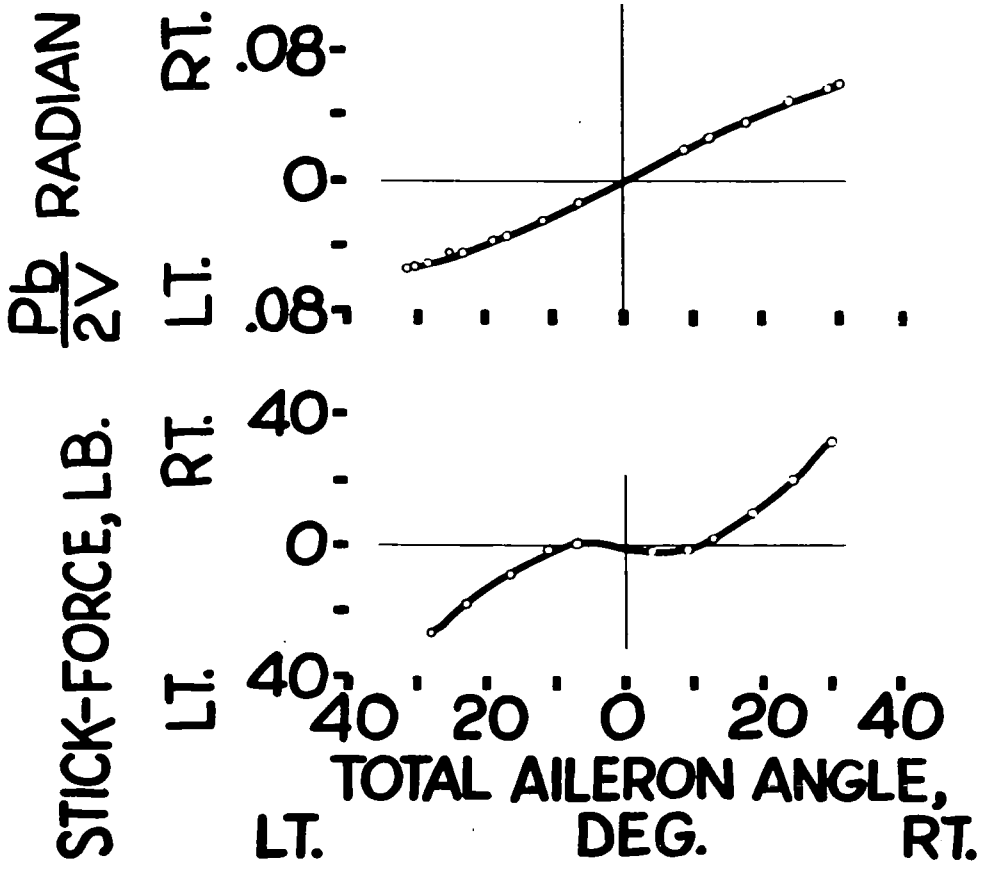

Figure 19. NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS LMAL 4035

AILERON EFFECTIVENESS OF VARIOUS FIGHTER AIRPLANES WITH 50 LB. STICK FORCE

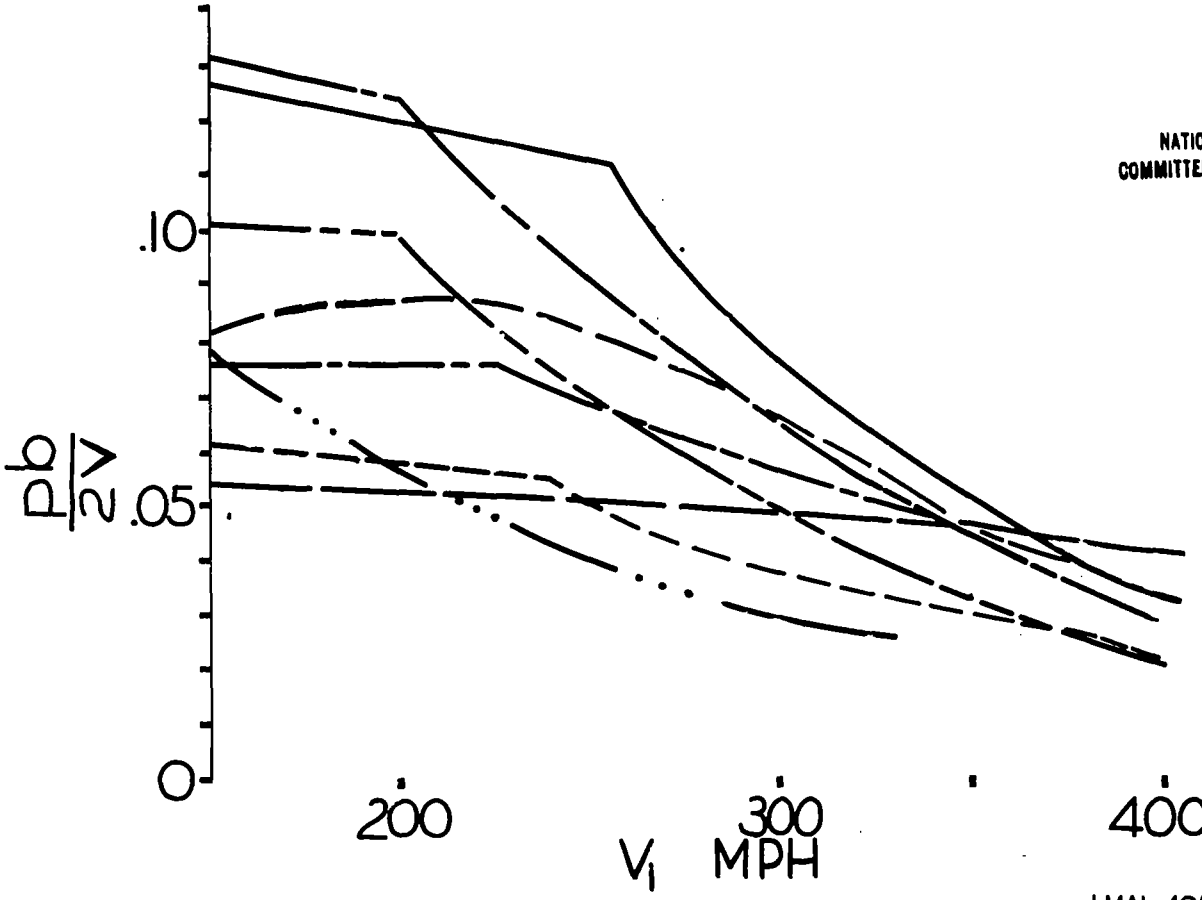

Figure 20

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UNSATISFACTORY DIRECTIONAL TRIM CHARACTERISTICS

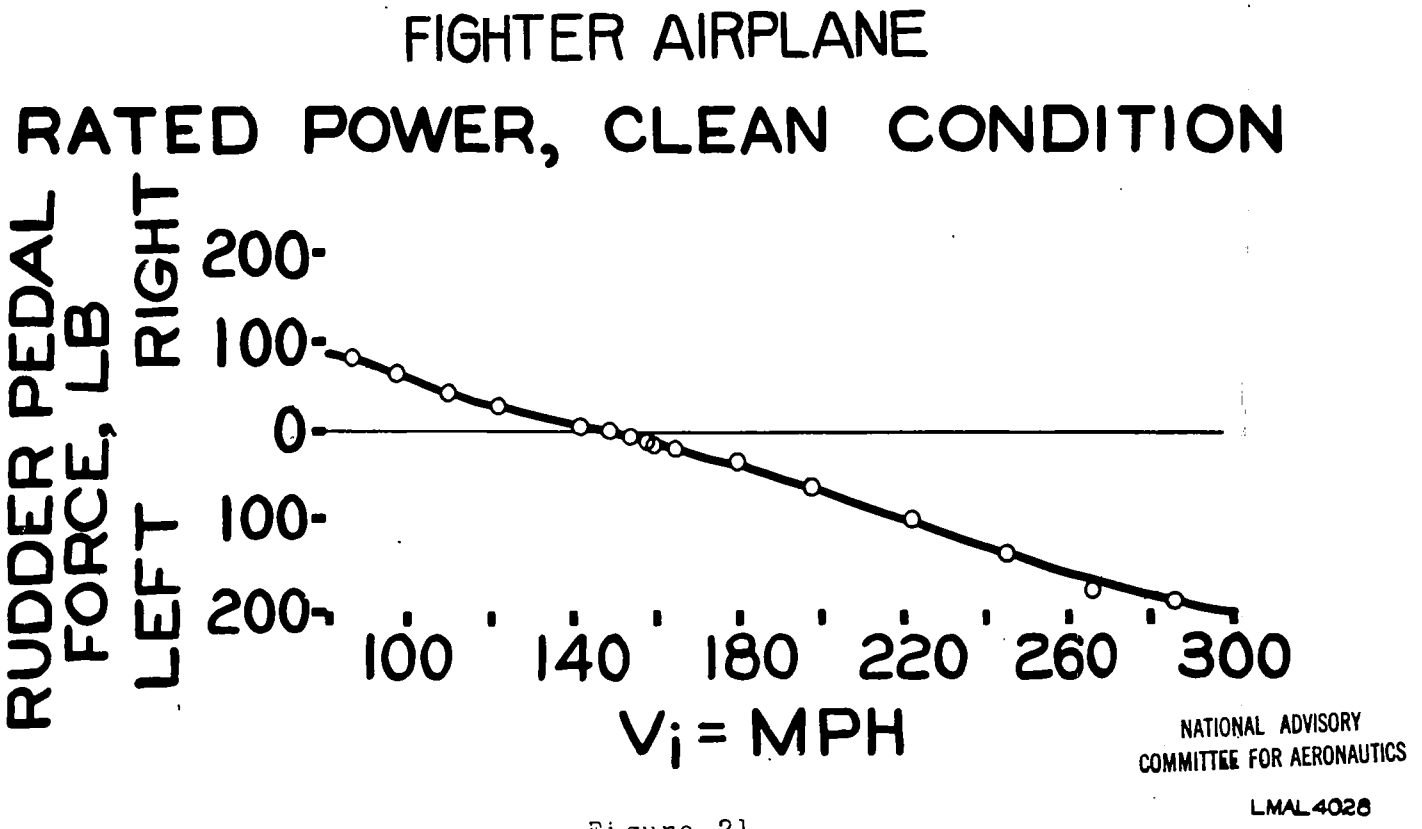

Figure 21.

MR No. L4L26

SATISFACTORY DIRECTIONAL TRIM CHARACTERISTICS

ATTACK BOMBER
RATED POWER, CLEAN CONDITION

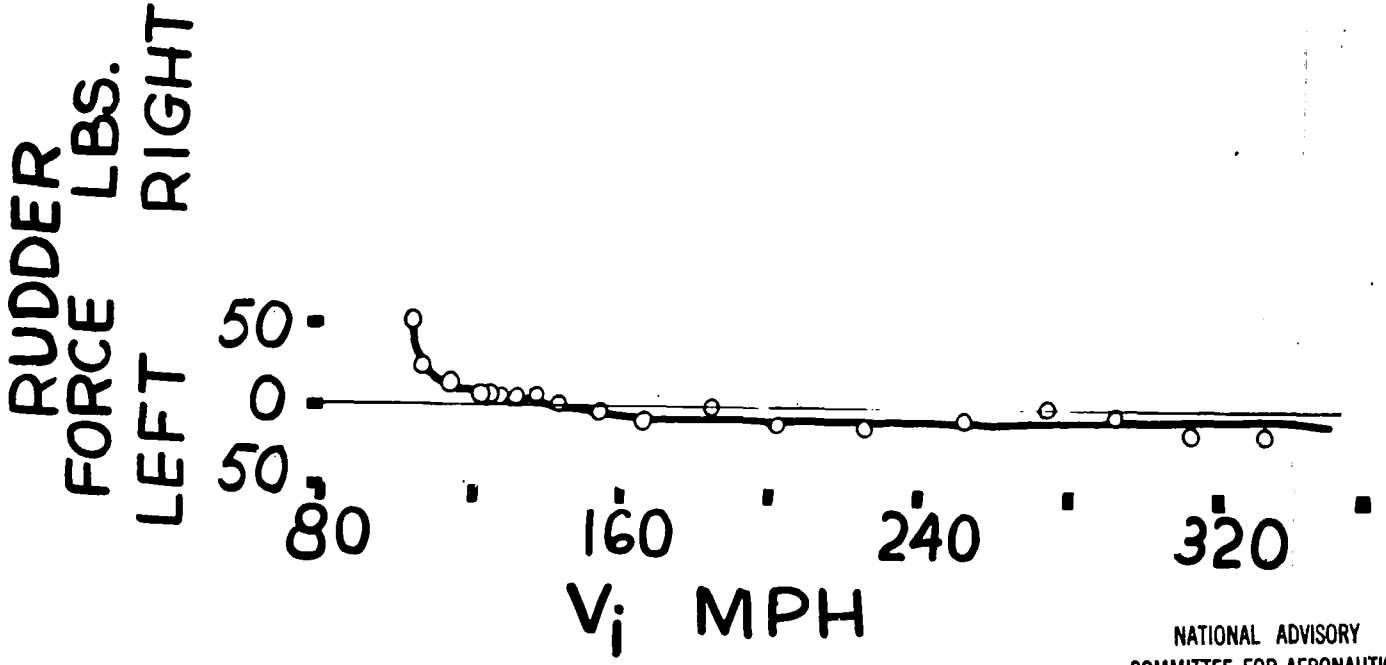

Figure 22.

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EFFECT OF LATERAL C.G. SHIFT ON RUDDER DEFLECTION REQUIRED FOR TRIM

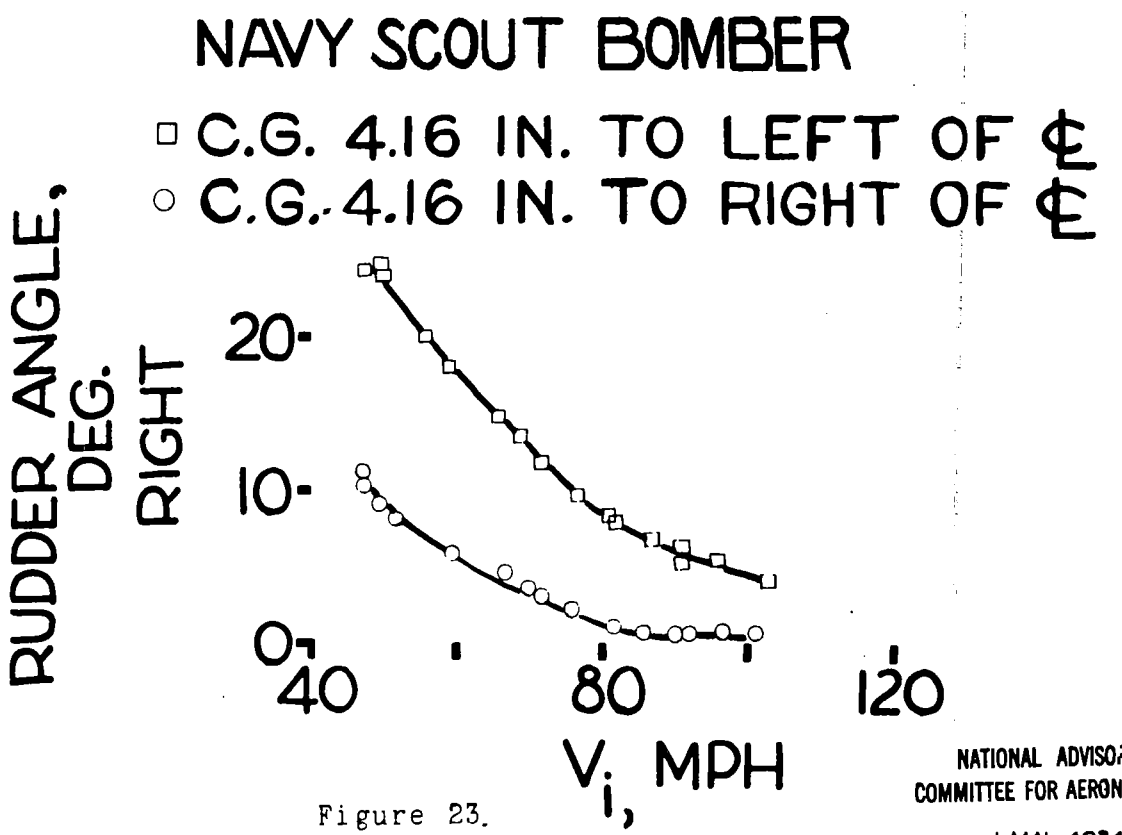

Figure 23.

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SATISFACTORY DIRECTIONAL STABILITY CHARACTERISTICS

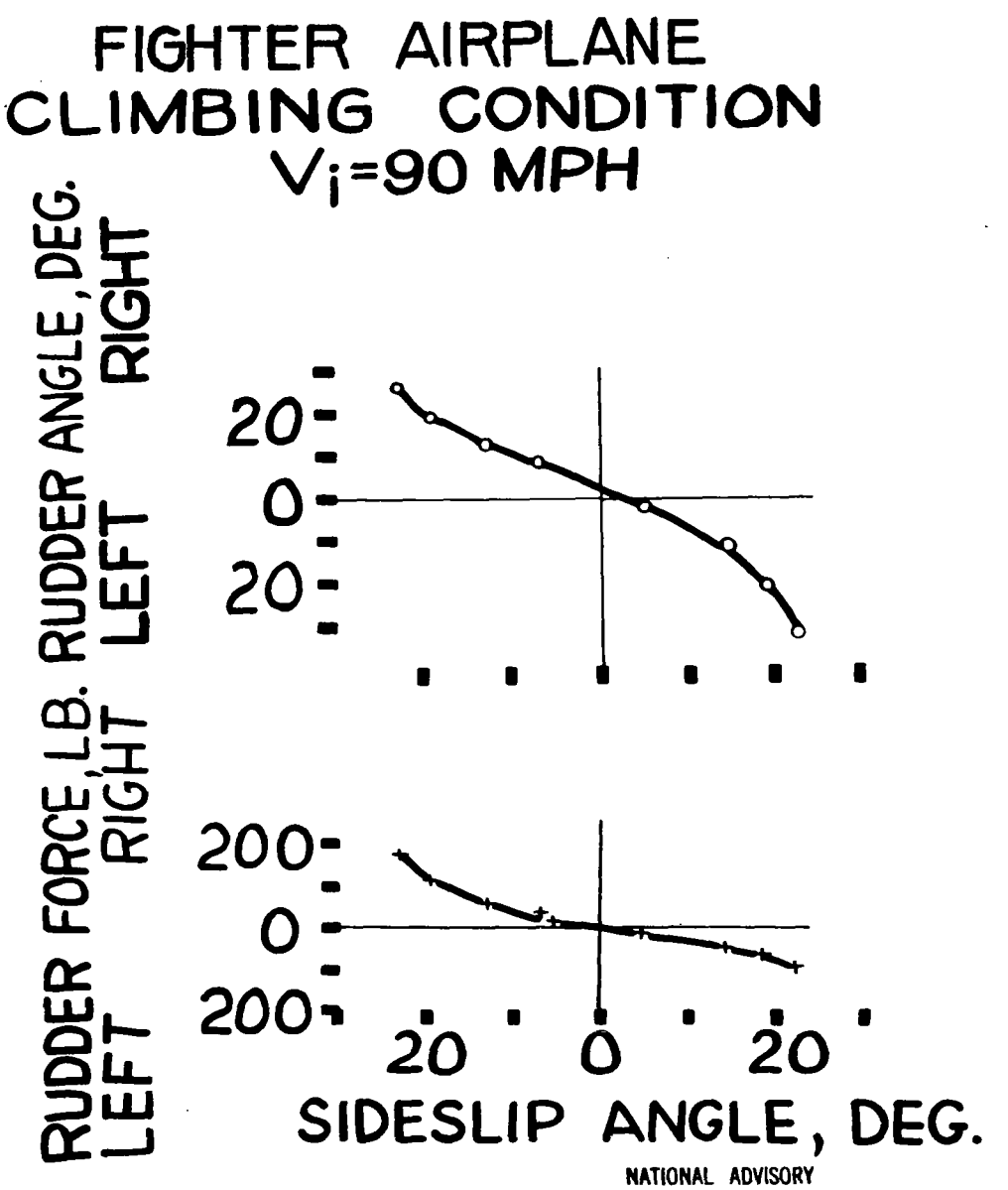

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Figure 24.

UNSATISFACTORY RUDDER FREE STABILITY
NAVY SCOUT BOMBER, CLIMBING CONDITION, V_i = 120 MPH

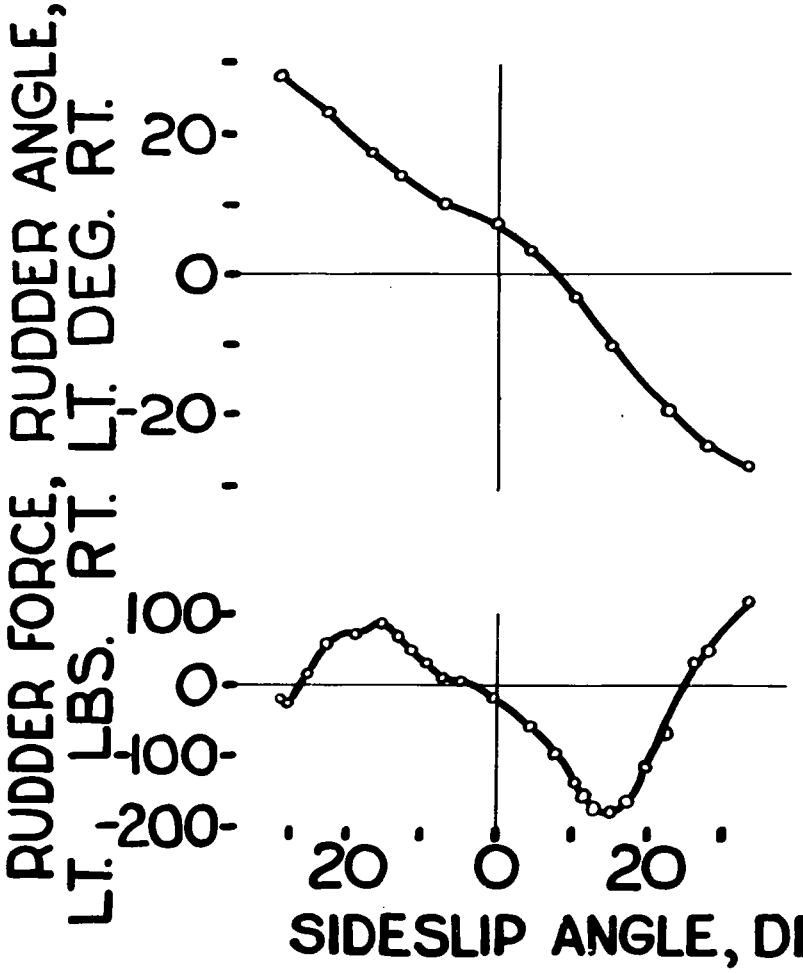

Figure 25.

UNSATISFACTORY RUDDER FIXED STABILITY

NAVY TORPEDO BOMBER, GLIDING CONDITION V_i = 92 MPH

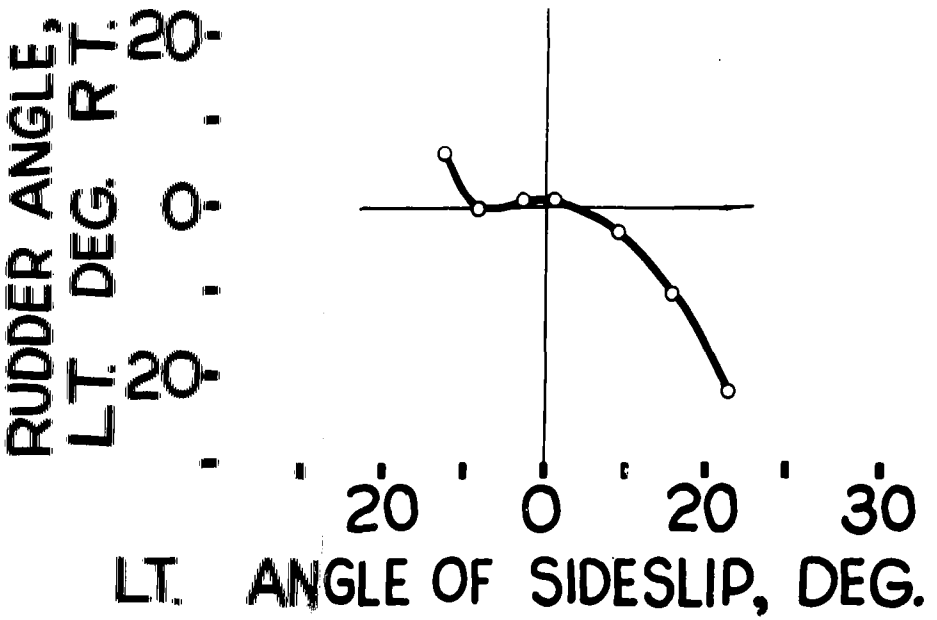

Figure 26.

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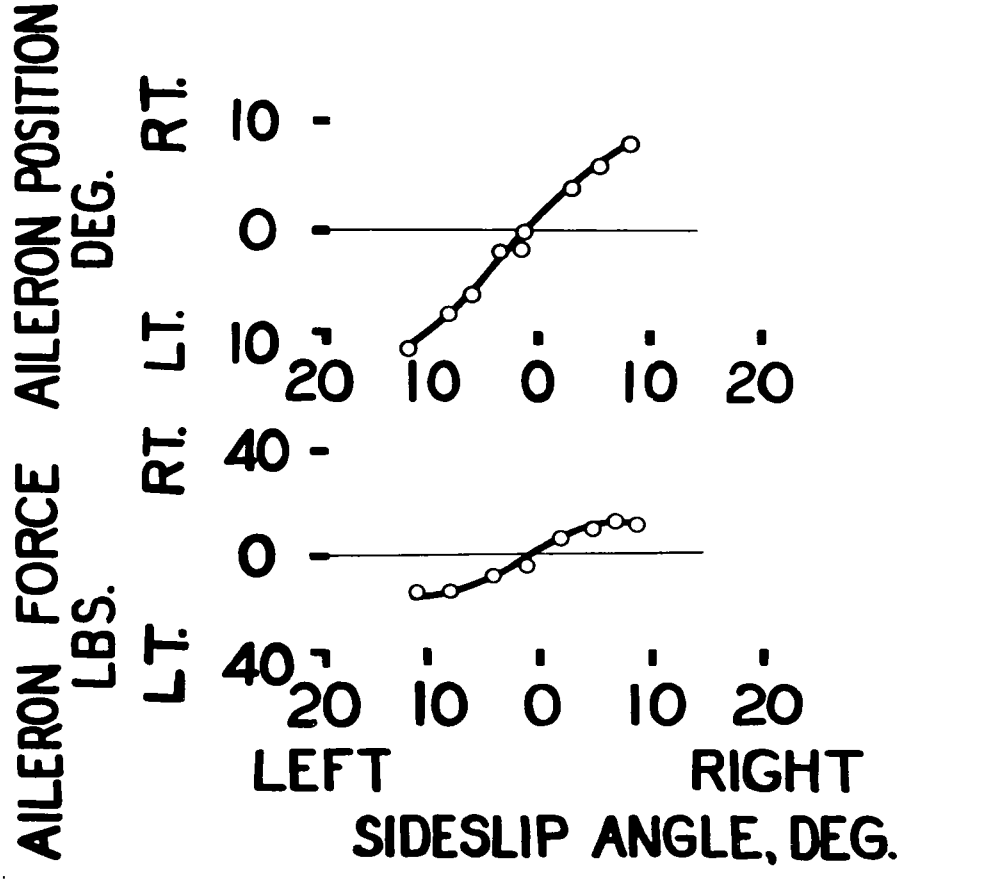
MR No. L41L26

SATISFACTORY STICK FIXED AND STICK FREE DIHEDRAL EFFECT

FIGHTER AIRPLANE
CLIMBING CONDITION, 252 MPH



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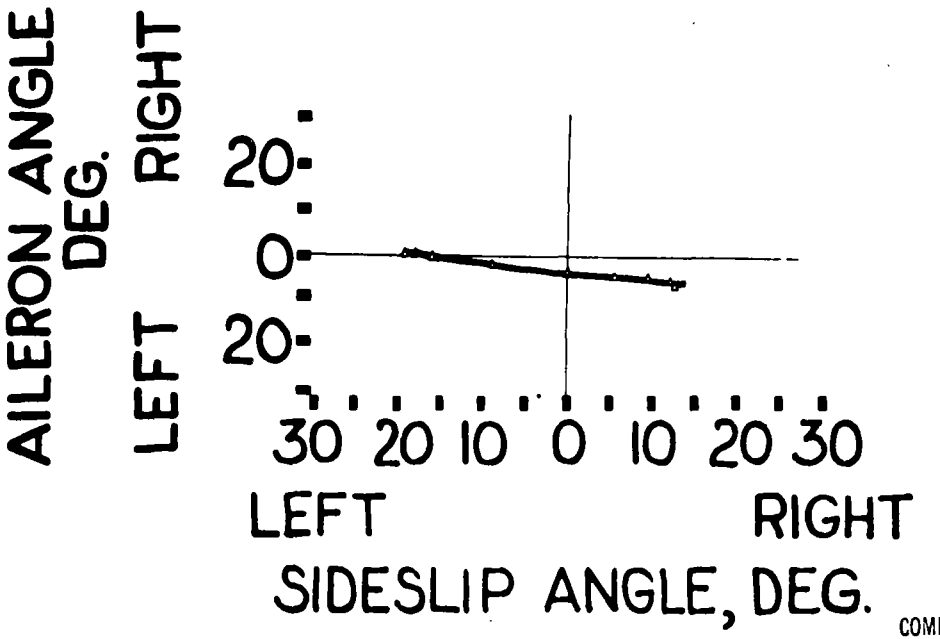
LMAL 4029

Figure 27.

UNSATISFACTORY STICK FIXED DIHEDRAL EFFECT

FIGHTER AIRPLANE
LANDING CONDITION
V_i = 120 MPH



NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

LMAL 4030

Figure 28.

MR No. L4L26

UNSATISFACTORY STICK FREE DIHEDRAL EFFECT

FIGHTER AIRPLANE
CLEAN CONDITION, RATED POWER
V_i=110 MPH

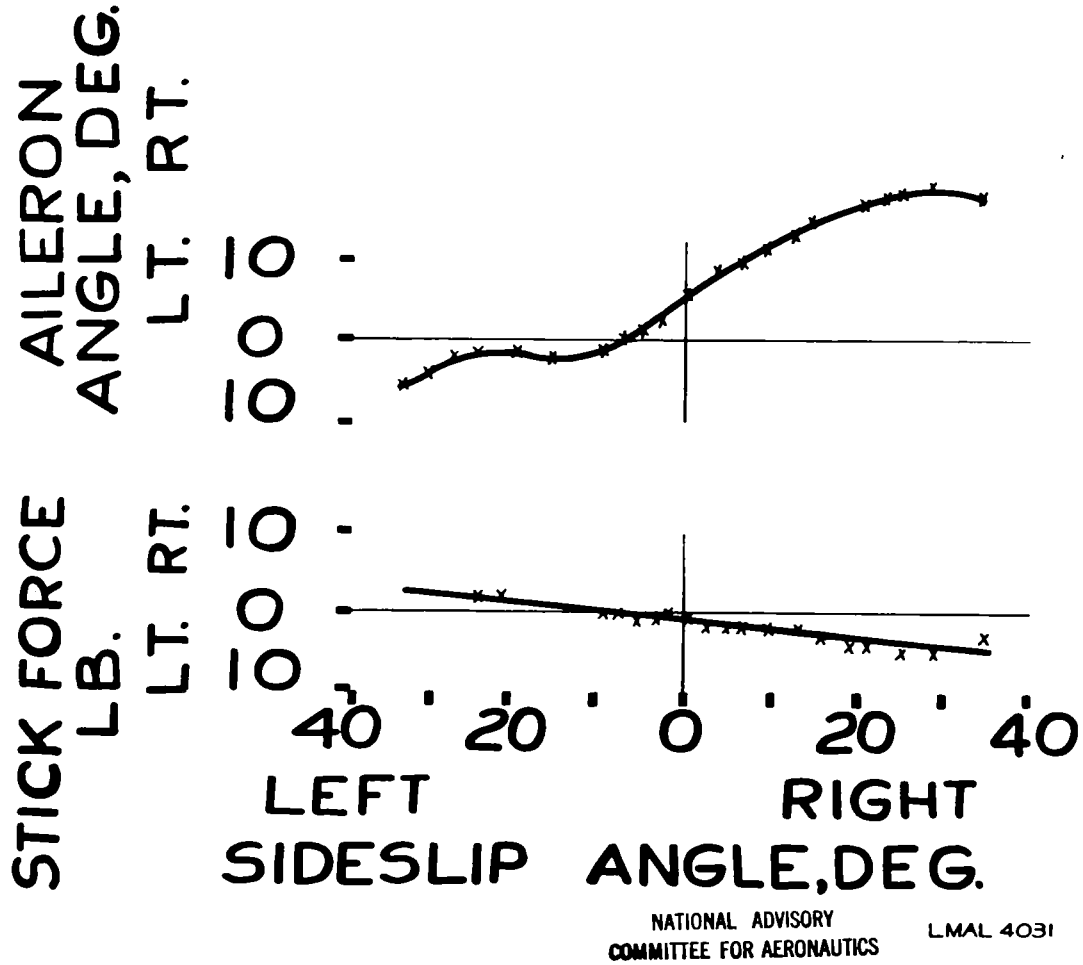


Figure 29.

SATISFACTORY PITCHING MOMENT DUE TO SIDESLIP

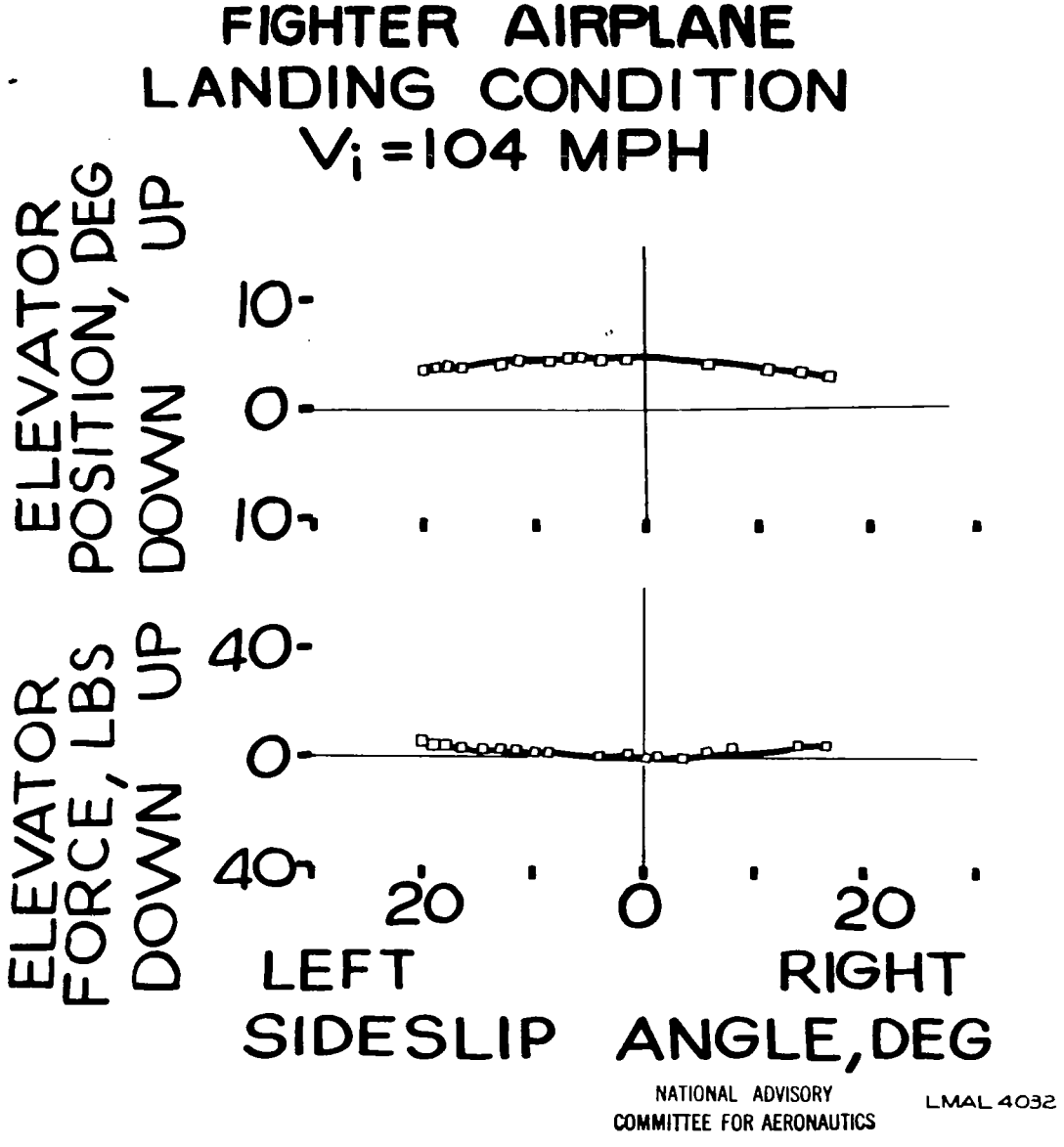


Figure 30.

UNSATISFACTORY PITCHING MOMENT DUE TO SIDESLIP

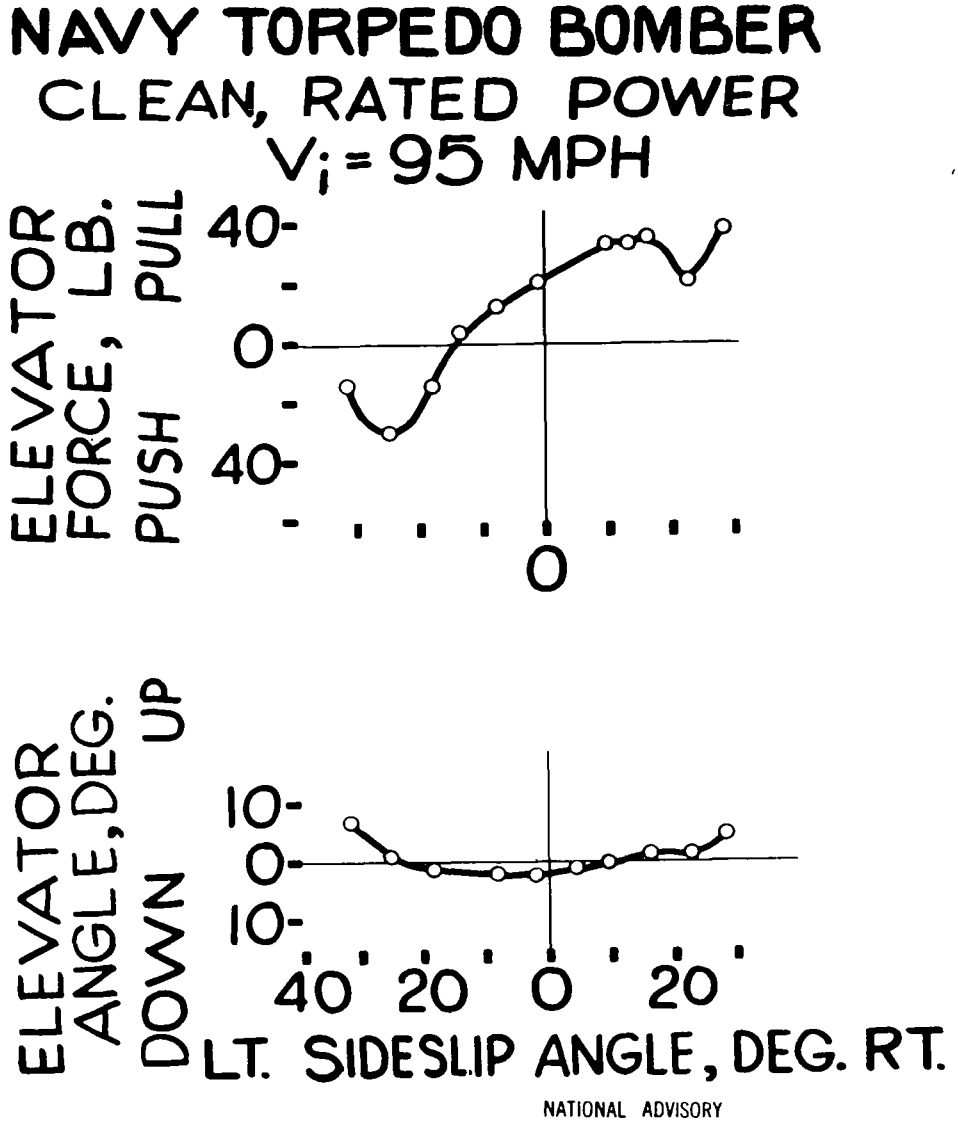


Figure 31.